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ENERGY MANAGEMENT APPLICATIONS FOR RECOVERING THE HEAT FROM WASTE WATER

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Abstract: *It is a fact that the waste water in the sewage has a certain temperature, varying from 8 degrees in winter to 18 degrees during the summer. The solution for using this heat is to put on the sewage pipes bottom, especially for the main pipes, heat exchangers able to recover a certain amount of heat usable for building heating. Therm Liner is easy to apply and less costing comparing with other methods such as drilling or embedding a pipes network in the soil, to a certain depth - in order to capture the geothermal heat. More costing is the air – air method, when the heat pump is using the environment, which does not have constant temperature.*
Key words: *heating, cost, sewage, economy, new*

1. INTRODUCTION

Our method is to recover the heat of the waste water from city sewage. The yearly average temperature of the waste water in the sewage is up to 12-13 degrees and the water can be used to recover a ratio of their heat and to transfer it to buildings. On the other hand, the waste waters' temperature is transferred to the environment and this is leading to (especially when the waste water is dumped into lakes or rivers) a significant alteration of the temperature of the recipient environment, affecting the ecosystems. In industrial areas, especially where there is heat generating processes the impact over the environment is more significant because the heated water is dumped directly into the environment or into the sewage.

The recherché we are presenting is highly applicative and does not theoretical citations.

The method is to put on the bottom of the sewage pipe the heat exchangers. The heat exchangers (see figure 1) will be submerged under the waste water and thus will be able to capture a part of the waste water heat using water-water heat pumps. We must emphasise that during the summer the system can act as cooling system, due to its reversing features, only with small adjustments.

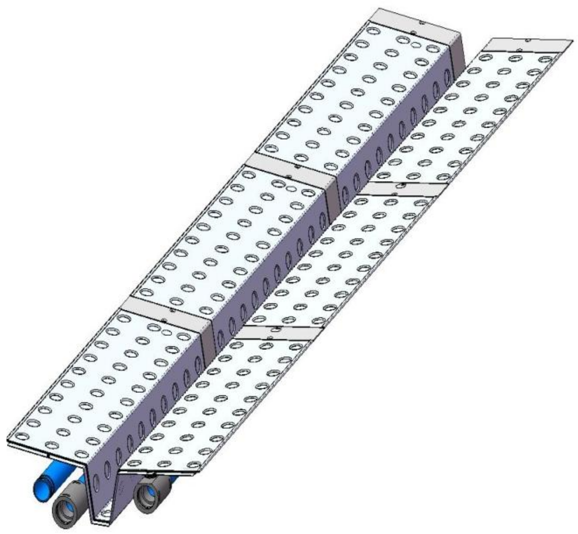

Fig. 1. The heat exchangers

As advantages of the system we have to mention:
1. it is easy to adapt to any pipe shape section
2. it is easy to et up and is expandable
3. is not interfering the normal sewage works
4. long lifespan (over 50 years)

The data we have gathered after using this method are encouraging and are recommend it as an alternative to other systems, in order to stop the waste of energy:
a. waste water energy extracted – 1-4 KWh/ m
b. investment cost – 800-1800 euro/KW
c. CO2 annual saving - 60-70%
d. heating cost saving - 40-60%
e. amortization – 4-10 years

2. EQUIPMENT TECHNICAL DATA AND WORKING PRINCIPLES

Therm Liner system is using the existing heating equipments of a building, thus being connected directly to the building heating system and provides 50 to 60 degrees hot water. The system features the following modules:
a. existing heating network of a building
b. heating pump, replacing existing heating source
c. recirculation pump for transporting the heat exchange liquid from the heat pump to heat exchanger and back
d. the heat exchanger placed in the sewage

The working principle is presented in figure 2.

The heat exchanger is made of 800 mm long sections of stainless steel that can be put together easy using a Lego type system. There shape and transversal section are custom made using the diameter and shape of the pipe where is going to be placed. The objective is to have a lower flow resistance and to ensure a higher heat exchange surface.

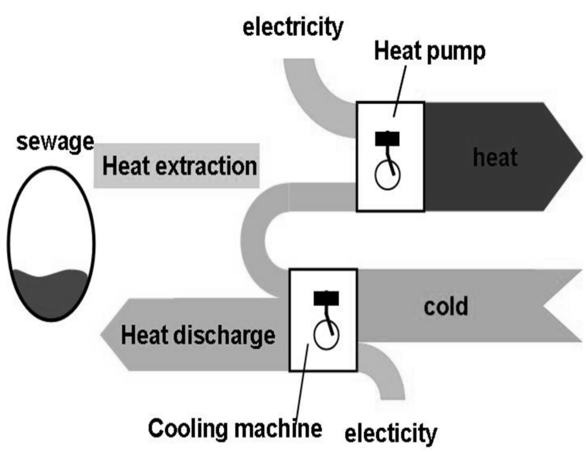

Fig. 2. The working principle

The dimensioning of the total length of the heat exchanger modules is made based on the following data:
a. waste water flow (a minimum of 15 litres/second is recommended)
b. diameter of pipe (a minimum of 500 mm is recommended)
c. pipe gradient
d. waste water yearly average temperature.
Considering the above mentioned features, one can see that a cluster of heat exchangers with a certain length can actually chill the waste water too much. This conclusion will be entered in our computing in order not to deactivate the bacteria performing the biological stage in the treatment plant.

3. THERM LINER SYSTEM APPLIED TO A SCHOOL CAMPUS IN SEBES CITY ROMANIA – PROJECT TO BE FINANCED WITH EUROPEAN FUNDS.

The project was designed by the Uhrig team, the patent owners, together with a group of specialists from the 1 Decembrie 1918 University in Alba Iulia.
For the given situation, two of the necessary prerequisites were missing, namely the pipe diameter was below 500 mm and the pipe gradient was below 1/1000. Considering this, we have decided to replace the existing pipe over a distance of 70 meters with a new pipe featuring a higher diameter (700 mm) and to assemble the heat exchanger into this section. Due to the very small speed of the waste water flow, because of the small gradient, our solution was to put a pneumatic controlled mobile dam in front of the heat exchanger. The role of the dam is to release the water 5 to 7 times a day in order to flood the heat exchanger, thus washing and avoiding waste accumulation and, also, to ensure a constant flow in the pipe be fixing it to a certain height.
The school campus comprise of four buildings as follows:
a. C1 – building for primary school
b. C2 – building for secondary school
c. C3 – building for kindergarten
d. C4 – sport hall
Foreseen solution:
a. waste water heat recovering system
b. water-water heat pump for heating the four buildings
c. heating network with static radiators for school and kindergarten
Sewage characteristics
a. form - ovoid
b. dimensions – 500x700 mm
c. gradient – 1/1000
d. dry weather flow – 68 l/s (minimum), 140 l/s (average)
e. waste water temperature – 12 degrees minimum
f. available length – 100 meters
g. heat transfer surface, fully submerged – 0,58 sqm./m
h. microbiological deposit layer influence - 40%
Heat exchange characteristics:
a. total length – 80 meters
b. minimum extraction capacity – 114 KW
c. heat pump power - 31 KW
d. heating capacity – 145 KW
e. heating pump performance factor – 4,7
Economic features

usage	unit	Therm Liner	Classic
power	KW	145	145
Year usage for heating	h	3950	3950
Cold weather heating energy conventional	KWh	73250	293000
Cold weather heating energy Therm Liner	KWh	219750	
Heat exchanger cost	euro	248805	
Drying cost	euro	9520	
Heat pump cost	euro	35105	
Conventional system cost	euro		41412
Installation cost	euro	32904	36282
Total cost	euro	325524	77694

Annual savings in comparison

features	unit	base	Therm Liner	classic
Annual operating cost	euro		952	952
Electricity cost	euro	35	35	35
Gas cost	euro	345		345
Electricity charge	ct/KWh	12	6201	
Gas charge	ct/KWh	31	22708	90830
Total annual operating cost	euro		29896	92162
Annual economy	euro		62266	
	%		68	

Natural gas reduction – 219750 KWh
CO2 reduction – 48931 kg/year
Amortization with no incentives – 4 years
4. Conclusions
We must emphasis that this project is finished in terms of design and is ready to be submitted for financing. Also, worth mentioning that our project is modern, reliable and efficient by featuring:
a. the use of renewable energy with the help of the most modern heating source – the heat pump
b. lack of CO2 emissions, thus is contributing to the actions of reducing the global warming
c. we are making a mixing of high capacity by capturing the residual heat from sewage with low costs for investing and operating
d. comparing with a classic heating gas system, our system reduces the heating costs with 55%
e. the project provides a long lifespan and reliability for the beneficiary
f. the amortization period is short
g. the system is reversible, thus being able to provide cool air with minimum of supplemental investment
h. the system allows other combination – it can be used as heating system or as worm water supplier for other heating systems.

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